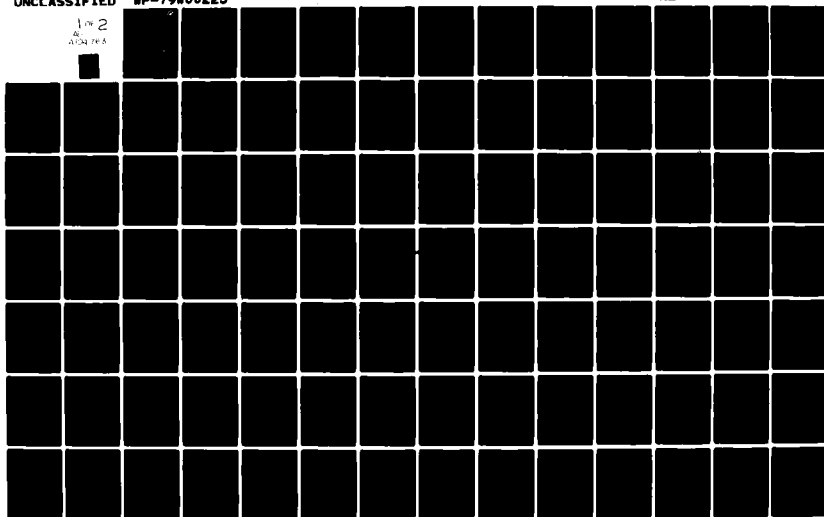


AD-A104 763

MITRE CORP MCLEAN VA METREK DIV F/G 6/20  
EVALUATION OF SHORT-TERM BIOASSAYS TO PREDICT FUNCTIONAL IMPAIR--ETC(U)  
OCT 80 P GREENAWAY, J KONZ, R THOMAS DAMD17-76-C-8066  
WP-79W00223 NL

UNCLASSIFIED

1 of 2  
AL  
ADONIS 763



L

II

AD

AS 12

# EVALUATION OF SHORT-TERM BIOASSAYS TO PREDICT FUNCTIONAL IMPAIRMENT

## DEVELOPMENT OF HEPATIC BIOASSAYS IN LABORATORY ANIMALS

### DIRECTORY OF INSTITUTIONS/INDIVIDUALS Final Report

Purna Greenaway, Jim Konz, Richard Thomas

October 1980

Supported by  
US Army Medical Research and Development Command  
Fort Detrick, Frederick, Maryland 21701

Contract No. DAMD17-78-C-8068 ✓

The MITRE Corporation  
1820 Dolley Madison Boulevard  
McLean, Virginia 22102

Contracting Officer's Technical Representative: Mary C. Henry, Ph.D.  
US Army Medical Bioengineering Research and Development Laboratory  
Fort Detrick, Maryland 21701

DTIC  
ELECTE  
S SEP 30 1981 D

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

The findings in this report are not to be construed as an official Department of the Army position  
unless so designated by other authorized documents.

AD A104763

DTIC FILE COPY

48

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A104	3. RECIPIENT'S CATALOG NUMBER 263
4. TITLE (and Subtitle) EVALUATION OF SHORT-TERM BIOASSAYS TO PREDICT FUNCTIONAL IMPAIRMENT, Development of Hepatic Bioassays in Laboratory Animals, Directory of Institutions/Individuals,		5. TYPE OF REPORT & PERIOD COVERED Final Directory - September 1978 - July 1980
7. AUTHOR(s) Purna Greenaway, Jim Konz, Richard Thomas		6. PERFORMING ORG. REPORT NUMBER WP-79W00223
9. PERFORMING ORGANIZATION NAME AND ADDRESS The MITRE Corporation 1820 Dolley Madison Boulevard McLean, Virginia 22102		8. CONTRACT OR GRANT NUMBER(s) DAMD 17-78-C-8068
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Medical Research and Development Command Fort Detrick, Frederick, MD 21701		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 61102A 3E161102BS04 001046
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Medical Bioengineering Research and Development Laboratory Fort Detrick, Frederick, MD 21701		12. REPORT DATE October 1980
		13. NUMBER OF PAGES 134
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Hepatotoxicity      Biochemical Tests Directory      Test Systems Utilized Research Organizations      Compounds Tested Morphological Tests      Toxic Substances Functional Tests		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) MITRE has been requested by the U.S. Army Medical Bioengineering Research and Development Laboratory to identify and evaluate short-term bioassays which have demonstrated ability to evaluate and predict hepatic impairment resulting from toxicant exposures. This directory is a companion to <u>Selected Short-Term Hepatic Toxicity Tests</u> , which describes the available hepatic testing protocols and assesses their suitability for a screening program. This direc- tory catalogues the organizations currently engaged in hepatic bioassay util- ization or development, and provides information concerning specific		

measurements performed, test systems employed, compounds tested, requirements for anesthesia, and the terminal nature of the test.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

SEP 30 1981

S D

## EXECUTIVE SUMMARY

The MITRE Corporation, Metrek Division is currently assisting the United States Army Medical Bioengineering Research and Development Laboratory (USAMBRDL) in the development of a hierarchical short-term testing scheme to screen substances for functional or morphological impairment in animal test systems. Effects in four organ systems--pulmonary, hepatic, renal, and cardiovascular--are being considered.

As part of this effort, Metrek has been asked to prepare directories of organizations and individuals presently involved in the development and/or utilization of tests applicable to toxicity screening. This directory serves as a companion document to the report entitled Evaluation of Short-Term Bioassays to Predict Functional Impairment: Selected Short-Term Hepatic Toxicity Tests, which presents information on the available tests for the hepatic system and recommends those tests that are suitable for use in a screening program. Test procedures for determining toxic effects on the liver are discussed in the report in sections on morphology, function, and biochemistry. Criteria for evaluating the procedures are given, and a three-tiered testing system is recommended for a chemical hepatotoxicity screening program.

Entries in each directory for several organizations currently involved in the organ bioassay use or development include at least one contact individual's name, which appears under the organization

name and address at the top of the page. These are the people who, during the process of directory compilation, described either their activities or the activities of their group regarding organ toxicity testing, and thereby provided the information presented in the entry. The information provided includes the specific tests and observations performed; the test systems utilized (e.g., experimental animals or tissues in vitro); the substances administered or conditions established to elicit toxic response (e.g., stress); the use of anesthesia, and the terminal nature of the tests conducted.

In order to facilitate use and the processes of amending and adding to the directory, it has been arranged in alphabetical order by organization. In order to further simplify use of the directory, three indexes have been prepared and are included as appendices. The first, Appendix A, is an alphabetical index of tests performed by each organization engaged in developing, performing or refining the tests noted. Appendix B is an alphabetic index of species utilized and all the organizations employing each test system. These are further divided by tests performed. In this way it is possible to ascertain which organizations perform particular bioassays in a specific test system. Appendix C is an alphabetical index of the individuals mentioned in the directory, and the organization with which they were affiliated when contacted.

The objective of this directory is to provide a readily usable guide to that segment of the scientific community currently active

in organ system toxicity testing in animals. Because research associate and graduate student positions are often temporary in nature, a deliberate attempt was made to exclude these individuals from the directory. Their efforts, however, are likely to be represented by activities associated with their organization, as in most cases these individuals are conducting research under the auspices of someone more senior and more permanently allied with the organization, who was included in the directory. In addition, there are individuals who were active in toxicity testing at one time but are no longer; these have also been omitted from the directory. The efforts of many of those who are not currently active, but were involved over a period of many years and distinguished themselves in the field, are reflected in the report, Selected Short-Term Hepatic Toxicity Tests.

Some of the entries in this directory may be less detailed than others, and less specific in the detail that is presented. In addition, the information presented for an organization may not be reflective of all the ongoing efforts at that organization. This is due largely to the reluctance of some individuals contacted to communicate the information and, in small part, to an inability to contact a few individuals at the time this directory was being compiled. The information in the directory was selected to provide an immediate indication of the practices of each organization concerning some issues of importance when designing a screening program. Much of this information is discussed in greater detail in the report Selected Short-Term Hepatic Toxicity Tests.

## FOREWORD

This Directory was compiled by MITRE staff by means of a survey of the recent literature, and by discussions with leaders in the field and other personal contacts. We are grateful to all those who responded so patiently to our questions regarding their activities. All of the "contact persons" were given an opportunity to review the information relating to their organization. We recognize there may be inadvertent omissions for which we offer our sincere apologies.

Citations of organizations and trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.



## TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	1
FOREWORD	5
DIRECTORY OF ORGANIZATIONS CURRENTLY INVOLVED IN UTILIZATION OR DEVELOPMENT OF HEPATIC TESTS IN ANIMALS	9
APPENDIX A - TESTS PERFORMED BY EACH ORGANIZATION	63
APPENDIX B - TEST SYSTEMS UTILIZED BY EACH ORGANIZATION	77
APPENDIX C - INDEX OF INDIVIDUALS IN THE DIRECTORY	131

DIRECTORY OF ORGANIZATIONS  
CURRENTLY INVOLVED IN UTILIZATION  
OR DEVELOPMENT OF HEPATIC TESTS IN ANIMALS

ORGANIZATION:

ABBOTT LABORATORIES  
ABBOTT PARK, NORTH  
CHICAGO, ILLINOIS 60064

J. W. KESTERSON (312)937-5763 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS:	GROSS OBSERVATION LIGHT MICROSCOPY ELECTRON MICROSCOPY
FUNCTIONAL TESTS:	DYE EXCRETION BILIRUBIN
BIOCHEMICAL TESTS:	SERUM ENZYME LEVELS CARBOHYDRATE METABOLISM LIPID METABOLISM PROTEIN METABOLISM VITAMIN METABOLISM LEVELS OF SERUM METALS AND ELECTROLYTES

TEST SYSTEMS UTILIZED:

RATS, DOGS, MONKEYS, MICE

COMPOUNDS TESTED:

ETHICAL PHARMACEUTICALS, PESTICIDES, INDUSTRIAL  
CHEMICALS, HOSPITAL PRODUCTS, DEVICES, PLASTICS

ORGANIZATION:

ALBERT EINSTEIN COLLEGE OF MEDICINE  
1300 MORRIS PARK AVENUE  
LIVER RESEARCH CENTER  
BRONX, NEW YORK 10461

R. CHOWDHURY (202)430-2379 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS:	GROSS OBSERVATION LIGHT MICROSCOPY ELECTRON MICROSCOPY
FUNCTIONAL TESTS:	DYE EXCRETION BILIRUBIN RADIOISOTOPIC TECHNIQUES
BIOCHEMICAL TESTS:	SERUM ENZYME LEVELS LIPID METABOLISM PROTEIN METABOLISM XENOBIOTIC METABOLISM LEVELS OF SERUM METALS AND ELECTROLYTES
<u>IN VITRO</u> TECHNIQUES	ISOLATED PERFUSED LIVER HEPATOCYTES HEPATOMA CELLS MEMBRANE INTEGRITY

TEST SYSTEMS UTILIZED:

RATS, RABBITS, MICE, GOATS, SHEEP, FISH

COMPOUNDS TESTED:

BILIRUBIN, DRUGS, POISONS (CARCINOGENS)  
VIRUSES, PROTEINS

REMARKS:

W. LEVINE, I. ARIAS AND J. SWANEY ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION:

AMERICAN HEALTH FOUNDATION  
VALHALLA, NEW YORK 10595

D. HOFFMAN (914)592-2600 (CONTACT)

TESTS PERFORMED:

STUDIES ARE GEARED TOWARD HEPATOCARCINOGENS AND MUTAGENS  
(i.e., TUMORIGENIC ACTIVITY AND DNA REPAIR)

TEST SYSTEMS UTILIZED:

MICE, RATS, RABBITS

COMPOUNDS TESTED:

ACETYLAMINE, BENZOPYRENE

REMARKS:

G. WILLIAMS IS ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

BAYLOR COLLEGE OF MEDICINE  
1200 MOURSUND  
HOUSTON, TEXAS 77030

H. HUGHES (713)790-4721 (CONTACT)

TESTS PERFORMED:

BIOCHEMICAL TESTS: LIPID METABOLISM  
XENOBIOTIC METABOLISM

TEST SYSTEMS UTILIZED:

MICE, RATS

COMPOUNDS TESTED:

KNOWN HEPATOTOXINS

REMARKS:

J. MITCHELL, G. COCHRAN, C. SMITH, AND B. LAUTERBURG ARE ALSO  
INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

BIO-DYNAMICS  
EAST MILLSTONE, NEW JERSEY 08873

T. RUSSELL (201)873-2550 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP, ICG)  
BILIRUBIN (SERUM AND URINE LEVELS)  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (COMPREHENSIVE)  
CARBOHYDRATE METABOLISM (GLUCOSE LEVELS)  
LIPID METABOLISM (CHOLESTEROL LEVELS)  
PROTEIN METABOLISM (SERUM LEVELS,  
ELECTROPHORESIS)  
LEVELS OF SERUM METALS AND ELECTROLYTES  
VITAMIN METABOLISM  
DETOXIFICATION OR SYNTHESIS OF  
ESSENTIAL BODY CONSTITUENTS

TEST SYSTEMS UTILIZED:

DOGS, GUINEA PIGS, HAMSTERS, MICE, MONKEYS, RABBITS, RATS

COMPOUND TESTED:

PHARMACEUTICALS, INDUSTRIAL CHEMICALS, PESTICIDES,  
FOOD ADDITIVES

REMARKS:

W. RINEHART, G. HOGAN, J. OGRODNICK AND A. KNESEVITCH ARE  
ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY  
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

E. BERMUDEZ (919) 541-2070 (CONTACT)

TESTS PERFORMED:

DNA REPAIR IN PRIMARY RAT HEPATOCYTES

DNA DAMAGE AS MEASURED BY ALKALINE ELUTION

CHINESE HAMSTER OVARY/HYPOXANTHINE-GUANINE PHOSPHORIBOSYL  
TRANSFERASE MUTATIONAL ASSAY

TEST SYSTEMS UTILIZED:

RATS (IN VIVO AND IN VITRO PREPARATIONS)

COMPOUNDS TESTED:

POLYCYCLIC HYDROCARBONS  
NITROSOAMINES  
MYCOTOXINS  
AZO DYES  
AROMATIC NITRO COMPOUNDS  
AROMATIC AMINES

REMARKS:

BASIC RESEARCH IS IN DNA DAMAGE AND REPAIR INDUCED BY CHEMICALS.

B.BUTTERWORTH IS ALSO INVOLVED IN HEPATOTOXICITY TESTING.



ORGANIZATION:

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY  
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

J. BOND (919)541-2070 x 250 (CONTACT)

TESTS PERFORMED:

NOT INVOLVED WITH SCREENING TESTS: WORK IS IN BASIC RESEARCH

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

KNOWN CARCINOGENS (e.g., DINITROTOLUENE)

REMARKS:

BASIC RESEARCH IS IN MECHANISM OF HEPATOCYTE METABOLISM AND  
ISOLATED PERFUSED LIVER.

ORGANIZATION:

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY  
P.O. BOX 12137  
RESEARCH TRIANGLE PARK  
NORTH CAROLINA 27709

E. GRALLA (919)541-2070 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
LIPID METABOLISM  
PROTEIN METABOLISM  
LEVELS OF SERUM METALS  
AND ELECTROLYTES

IN VITRO TECHNIQUES: HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

40 PRIORITY CHEMICALS

REMARKS:

J. POPP AND J. GIBSON ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.

ORGANIZATION:

DOW CHEMICAL USA  
MIDLAND, MICHIGAN 48640

P. GEHRING (517)636-1089 (CONTACT)

TESTS PERFORMED:

HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BROMSUL PHALEIN, BSP)  
BILIRUBIN (BILIARY TRANSPORT MAXIMUM)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (LACTIC ACID DE-  
HYDROGENASE, LDH AND OTHERS)  
PROTEIN METABOLISM (TURNOVER OF  
C<sub>14</sub>-LABELLED COMPOUNDS)  
NITROGEN METABOLISM (UREAGENESIS)  
LIPID METABOLISM (PHOSPHOLIPID  
LABELS)  
XENOBIOTIC METABOLISM

IN VITRO TECHNIQUES: CULTURED HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, MICE, DOGS, MONKEYS

COMPOUNDS TESTED:

PESTICIDES, SOLVENTS, MONOMERS, ETC.

REMARKS:

ALSO INVOLVED IN DNA REPAIR AND TURNOVER WITH IN VITRO  
HEPATOCYTES.

B.A. SCHWETZ AND R.J. KOCIBA ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.

ORGANIZATION:

DUKE MEDICAL CENTER  
DEPARTMENT OF PATHOLOGY  
DURHAM, NORTH CAROLINA 27710

G. MICHALOPOULOS (919) 684-2779 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: PHASE-CONTRAST MICROSCOPY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM IN THE CYTOCHROME  
P450 SYSTEM

IN VITRO TECHNIQUES: DNA REPAIR IN RAT HEPATOCYTES AND  
HUMAN FIBROBLASTS

TEST SYSTEMS UTILIZED:

HUMAN FIBROBLASTS AND RAT HEPATOCYTES

COMPOUNDS TESTED:

BENZO(A)PYRENE, AAF (ACETYLAMINOFLUORENE) AFLATOXINS  
DIETHYLNITROSAMINE

ORGANIZATION:

EXXON CORPORATION  
RESEARCH AND ENVIRONMENTAL HEALTH DIVISION  
EAST MILLSTONE, NEW JERSEY 08873

R. STAAB (201)873-6050 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION

FUNCTIONAL TESTS: DYE EXCRETION (BSP)  
BILIRUBIN (SERUM LEVELS)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
(GLUCOSE LEVELS)  
LIPID METABOLISM (CHOLESTEROL LEVELS)  
PROTEIN METABOLISM (SERUM AND URINE  
PROTEIN LEVELS)  
DETOXIFICATION (DEVELOPMENTAL STAGE)  
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

DOGS, MICE, RABBITS, RATS

COMPOUNDS TESTED:

HYDROCARBONS, PETROCHEMICALS, SOLVENTS, AND PETROLEUM  
ADDITIVES

REMARKS:

SCREENING PROGRAM IS NOT LIMITED TO THE HEPATIC SYSTEM.

R. SCALA, S. LEWIS, AND G.F. EGAN ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION:

FOOD AND DRUG RESEARCH LABORATORIES  
EAST ORANGE  
NEW JERSEY 07078

H. FEINMAN (201)677-9500 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: DYE EXCRETION TEST (BSP)  
BILIRUBIN (SERUM BILIRUBIN AND  
UROBILINOGEN LEVELS)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (COMPREHENSIVE)  
CARBOHYDRATE METABOLISM (COMPREHENSIVE)  
LIPID METABOLISM (COMPREHENSIVE)  
PROTEIN METABOLISM (COMPREHENSIVE)  
(PROTEIN EFFICIENCY RATIO FOR FOODS AND  
ADDITIVES)  
LEVELS OF SERUM METALS AND ELECTROLYTES  
(COMPREHENSIVE)  
VITAMIN METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS (ANTIDOTAL STUDIES)

TEST SYSTEMS UTILIZED:

CATS, DOGS, GUINEA PIGS, HAMSTERS, HUMANS, MICE, MONKEYS,  
PIGS, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED.

REMARKS:

R. PARENT, P. BECCI, AND G. COX ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION:

FOOD RESEARCH INSTITUTE  
UNIVERSITY OF WISCONSIN, MADISON  
1925 WILLOW DRIVE  
MADISON, WISCONSIN 53706

M. PARIZA (608)263-6955 (CONTACT)  
263-7777

TESTS PERFORMED:

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS:	GROSS OBSERVATION LIGHT MICROSCOPY
FUNCTIONAL TESTS:	MEMBRANE INTEGRITY
BIOCHEMICAL TESTS:	XENOBIOTIC METABOLISM DRUG METABOLISM
<u>IN VITRO</u> TECHNIQUES:	HEPATOCYTES HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

AFLATOXIN B<sub>1</sub>, AMINOFLUORENE, CLOSTRIDIUM PERFRINGENS ENTEROTOXIN

REMARKS:

EMPHASIS IS ON MUTAGENESIS

ORGANIZATION:

G.D. SEARLE AND COMPANY  
BOX 5110  
CHICAGO, ILLINOIS 60680

D. DODD (312)982-7000 x4981 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION  
BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
LIPID METABOLISM  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
LEVELS OF SERUM METALS  
AND ELECTROLYTES  
DETOXIFICATION  
PRODUCT SYNTHESIS

TESTS SYSTEMS UTILIZED:

DOGS, RATS, MONKEYS, MICE

COMPOUNDS TESTED:

PHARMACEUTICALS

REMARKS:

V. JASTY AND F. KOTSONIS ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.



ORGANIZATION:

GEORGE WASHINGTON UNIVERSITY HOSPITAL  
DEPARTMENT OF GASTROENTEROLOGY  
WASHINGTON, D.C. 20037

H. ZIMMERMAN (202) 676-4418 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: DYE EXCRETION

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
XENOBIOTIC METABOLISM

IN VITRO TECHNIQUES: PERFUSED LIVER  
HEPATOCYTE SUSPENSION

TEST SYSTEMS UTILIZED:

PERFUSED RAT LIVER AND HEPATOCYTE CULTURE.

COMPOUNDS TESTED:

CARBON TETRACHLORIDE, ENDOTOXINS, DRUGS

ORGANIZATION:

HAZLETON LABORATORIES  
VIENNA, VIRGINIA 22180

M. STEINBERG (703)893-5400 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP)  
BILIRUBIN (INDIRECT AND DIRECT)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (STANDARD)  
CARBOHYDRATE METABOLISM (GLUCOSE LEVEL)  
PROTEIN METABOLISM (URIC ACIDS, BUN,  
SERUM ELECTROPHORESIS AND CREATINE LEVELS)  
LIPID METABOLISM (CHOLESTEROL AND FREE  
FATTY ACID LEVELS)  
DETOXIFICATION  
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

GUINEA PIGS, MICE, MONKEYS, RABBITS, RATS, AND DOGS

COMPOUNDS TESTED:

AGRICULTURAL CHEMICALS (e.g., PESTICIDES), DRUGS, GENERAL  
CHEMICALS, COSMETICS, DYES, MILITARY CHEMICALS, ETC.

ORGANIZATION:

HOFFMAN LaROCHE INCORPORATED  
NUTLEY, NEW JERSEY 07110

E. FFITZER (201)235-3028 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP)  
BILIRUBIN (SERUM LEVEL)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM (SERUM GLUCOSE)  
LIPID METABOLISM (CHOLESTEROL AND  
TRIGLYCERIDE)  
PROTEIN METABOLISM (SERUM PROTEIN  
LEVELS)  
NITROGEN METABOLISM (UREAGENESIS)  
VITAMIN METABOLISM  
LEVELS OF SERUM ELECTROLYTES AND METALS

TEST SYSTEMS UTILIZED:

DOGS, GUINEA PIGS, MICE, MONKEYS, RABBITS, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF INDUSTRIAL CHEMICALS AND DRUGS HAVE BEEN  
TESTED.

REMARKS:

A. CONNEY AND S. KAPLAN ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.

ORGANIZATION:

INTERNATIONAL RESEARCH AND DEVELOPMENT CORPORATION  
MATTAWAN, MICHIGAN 40971

E. GOLDENTHAL (616)668-3336 (CONTACT)

TESTS PERFORMED:

HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN (SERUM BILIRUBIN LEVEL)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (COMPREHENSIVE)  
CARBOHYDRATE METABOLISM (COMPREHENSIVE)  
LIPID METABOLISM (COMPREHENSIVE)  
PROTEIN METABOLISM (COMPREHENSIVE)  
LEVELS OF SERUM METALS AND ELECTROLYTES (COMPREHENSIVE)  
VITAMIN METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS (HIPURIC ACID  
EXCRETION, PLASMA LEVELS OF COAGULATION FACTORS)

TEST SYSTEMS UTILIZED:

CHICKENS, DOGS, GUINEA PIGS, HAMSTERS, MICE, MONKEYS,  
PIGS, RATS, AND RABBITS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED.

ORGANIZATION:

LITTON BIONETICS INCORPORATED  
KENSINGTON, MARYLAND 20795

R. WEIR, OR H. GISS (301)881-5600 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP)  
BILIRUBIN (URINARY AND BLOOD LEVELS)

BIOCHEMICAL TESTS: SERUM ENZYMES (COMPREHENSIVE)  
CARBOHYDRATE METABOLISM (GLUCOSE LEVELS)  
LIPID METABOLISM (CHOLESTEROL)  
PROTEIN METABOLISM (SERUM LEVELS)  
XENOBIOTIC METABOLISM  
LEVELS OF SERUM ELECTROLYTES AND METALS

TEST SYSTEMS UTILIZED:

DOGS, MICE, MONKEYS, RATS

COMPOUNDS TESTED:

SOLVENTS	INDUSTRIAL CHEMICALS
PESTICIDES	PETROCHEMICALS
DRUGS	FOOD COLORS

REMARKS:

F. MECKLER AND C. JOHNSON ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION:

3M-RIKER LABORATORIES  
3M CENTER  
ST. PAUL, MINNESOTA 55144

M. CASE (612)733-5180 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN (SERUM LEVEL)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
PROTEIN METABOLISM (BUN MEASUREMENT AND  
SERUM PROTEIN LEVELS)  
CARBOHYDRATE METABOLISM (BLOOD GLUCOSE  
LEVEL)  
LIPID METABOLISM (CHOLESTEROL LEVEL)  
SERUM ELECTROLYTES ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ )

TEST SYSTEMS UTILIZED:

DOGS, RATS

COMPOUNDS TESTED:

PHARMACEUTICALS  
AGRO-CHEMICALS (e.g., HERBICIDES)  
INDUSTRIAL COMPOUNDS - INFORMATION IS PROPRIETARY.

REMARKS:

R. NELSON, E. LAMPRECHT AND R. STEFFEN ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
50 AMES STREET  
CAMBRIDGE, MASSACHUSETTS 02139

P. NEWBERNE (617)253-6243 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
HISTOCHEMISTRY

FUNCTIONAL TESTS: BILIRUBIN  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: TISSUE ENZYME LEVELS  
LIPID METABOLISM  
PROTEIN METABOLISM  
DRUG METABOLISM  
LEVELS OF SERUM METALS AND  
ELECTROLYTES  
LEVELS OF TISSUE (LIVER) METALS  
VITAMIN ASSAYS  
DETOXIFICATION

TEST SYSTEMS UTILIZED:

RATS, MICE, HAMSTERS, GUINEA PIGS, RABBITS, DOGS, MONKEYS

COMPOUNDS TESTED:

DRUGS, PURE CHEMICALS (PESTICIDES), NATURAL PRODUCTS (ALKALOIDS)

ORGANIZATION:

MEDICAL COLLEGE OF VIRGINIA  
DEPARTMENT OF PATHOLOGY  
RICHMOND, VIRGINIA 23298

P. GUZELIAN (904)786-9693 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM (SUGAR  
METABOLISM  
LIPID METABOLISM (PHOSPHOLIPID  
SYNTHESIS  
PROTEIN METABOLISM (FIBRINOGEN  
AND ALBUMIN SYNTHESIS)  
XENOBIOTIC METABOLISM IN THE CYTOCHROME  
P450 SYSTEM

IN VITRO TECHNIQUES: CULTURED HEPATOCYTES

TEST SYSTEMS UTILIZED:

HEPATOCYTE-CULTURE MEDIUM: RATS

COMPOUNDS TESTED:

CARCINOGENS, STEROIDS, MYCOTOXINS, METALS

REMARKS:

F. FALLON AND D. GOLDMAN ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.



ORGANIZATION:

MIDWEST RESEARCH INSTITUTE  
425 VOLKER BLVD.  
KANSAS CITY, MISSOURI 64110

T. SHELLENBERGER (816)753-7600 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION  
BILIRUBIN  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
LIPID METABOLISM  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
VITAMIN METABOLISM  
DRUG METABOLISM  
LEVELS OF SERUM METALS AND ELECTRO-  
LYTES  
DETOXIFICATION  
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES  
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS, MICE, RABBITS, DOGS, MONKEYS, HAMSTERS, GUINEA PIGS

COMPOUNDS TESTED:

ANTI-CANCER DRUGS, NITROSAMINES, PESTICIDES, RDX, VINYL  
TOLUENE, VINYLIDENE CHLORIDE, DEVELOPMENTAL COMPOUNDS

REMARKS:

B. BARNHART, H. ELLIS, M. EL-HAWARI AND J. CHOLAKIS ARE  
ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

MONSANTO COMPANY  
ST. LOUIS, MISSOURI 63166

F. JOHANSEN (314)694-2183 (CONTACT)

TEST PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY  
MORPHOMETRIC ANALYSIS

FUNCTIONAL TESTS: DYE EXCRETION  
BILIRUBIN  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM (GLUCOSE, LACTASE,  
RIBOSE LEVELS)  
LIPID METABOLISM (CHOLESTEROL, PHOSPHO-  
LIPID, FREE FATTY (ACIDS))  
PROTEIN METABOLISM (SERUM AND URINE  
LEVELS, URINARY CREATININE, BUN)  
LEVELS OF SERUM METALS AND ELECTROLYTES  
(Na<sup>+</sup>, Cl<sup>-</sup>, HEAVY METALS)  
DETOXIFICATION  
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

DOGS, HAMSTERS, RABBITS, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF INDUSTRIAL COMPOUNDS HAVE BEEN TESTED.

REMARKS:

G. LEVINSKAS, P. WRIGHT AND R. FOLK ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION:

NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES  
NATIONAL TOXICOLOGY PROGRAM  
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

J. HUFF (919)541-3267 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: HISTOLOGY

FUNCTIONAL TESTS: BILIRUBIN (SERUM LEVELS)  
RADIOISOTOPIC TECHNIQUES (OCCASIONALLY)

BIOCHEMICAL TESTS: PROTEIN METABOLISM (LIPOPROTEINS,  
ELECTROPHORESIS)  
LIPID METABOLISM (CHOLESTEROL AND  
TRIGLYCERIDES)  
XENOBIOTIC METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

DOGS, MICE, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED

REMARK:

H. MATTHEWS, J. GOLDSTEIN, W. KLUWE AND R. CHABRA ARE ALSO  
INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

NAYLOR DANA INSTITUTE  
1 DANA ROAD  
VALHALLA, NEW YORK 10595

G. WILLIAMS (914)592-2600 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: CELL NECROSIS  
DNA DAMAGE  
MUTAGENESIS

TESTS SYSTEMS UTILIZED:

RATS, MICE, HAMSTERS, RABBITS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED, INCLUDING 20  
STRUCTURAL CLASSES OF AGENTS WHICH ARE ACTIVATED BY THE LIVER.

ORGANIZATION:

NEW YORK UNIVERSITY MEDICAL CENTER  
NEW YORK, NEW YORK 10016

B. VAN DUUREN (212)340-5629 (CONTACT)

TESTS PERFORMED:

THE METABOLISM OF POTENTIAL CARCINOGENS IS THE PRINCIPAL FOCUS.

TEST SYSTEMS UTILIZED:

MICE, RATS

COMPOUNDS TESTED:

EPOXIDES, HALO-ETHERS, HALOGENATED HYDROCARBONS, LACTONES,  
ACYLATING AGENTS.

ORGANIZATION:

RUTGERS MEDICAL SCHOOL (CMDNJ)  
VIVARIUM  
P.O. BOX 101  
PISCATAWAY, NEW JERSEY 08854

J.R. McCoy (201)463-4570 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION  
BILIRUBIN  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
LIPID METABOLISM  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
VITAMIN METABOLISM

IN VITRO TECHNIQUES: HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS, DOGS, MICE, RABBITS, MONKEYS

COMPOUNDS TESTED:

PESTICIDES, ORAL CONTRACEPTIVES, STEROIDS, ENDOCRINE SUBSTANCES,  
OCCUPATIONAL CHEMICALS (e.g., HEAVY METALS), WRAPPING PLASTICS

ORGANIZATION:

STERLING WINTHROP RESEARCH INSTITUTE  
DEPARTMENT OF TOXICOLOGY  
RENSSELAER, NEW YORK 12144

H.P. DROBECK (518)445-8316 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
LEVELS OF SERUM METALS AND  
ELECTROLYTES

TEST SYSTEMS UTILIZED:

MICE, RATS, HAMSTERS, RABBITS, GUINEA PIGS, DOGS, MONKEYS

COMPOUNDS TESTED:

PHARMACEUTICALS, MEDICINALS

ORGANIZATION:

STERLING WINTHROP RESEARCH INSTITUTE  
DEPARTMENT OF DRUG METABOLISM AND DISPOSITION  
RENSSELAER, NEW YORK 12144

J. EDELSON (518)445-8241 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM (MICROSOMAL  
PREPARATIONS)  
DETOXIFICATION  
BIOSYNTHESIS

TEST SYSTEMS UTILIZED:

RATS, DOGS, MONKEYS, HUMANS

COMPOUNDS TESTED:

PHARMACEUTICALS, NATURALLY OCCURRING ENZYMES



ORGANIZATION:

TEMPLE UNIVERSITY  
DEPARTMENT OF PATHOLOGY  
PHILADELPHIA, PENNSYLVANIA 19140

J.L. FARBER (215)221-4155 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: LIGHT MICROSCOPY

BIOCHEMICAL TESTS: LIPID METABOLISM (PHOSPHOLIPIDS)  
XENOBIOTIC METABOLISM IN THE CYTOCHROME  
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

HALOGENATED HYDROCARBONS

REMARKS:

PRINCIPAL RESEARCH INTERESTS ARE THE MECHANISMS OF HEPATOTOXICITY.

ORGANIZATION:

TEMPLE UNIVERSITY SCHOOL OF MEDICINE  
SECTION OF CLINICAL PHARMACOLOGY  
3420 N. BROAD STREET  
PHILADELPHIA, PENNSYLVANIA 19140

M. BLACK (214)221-3434 (CONTACT)  
221-3260

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION  
BILIRUBIN  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
XENOBIOTIC METABOLISM  
LEVELS OF SERUM METALS AND ELECTROLYTES  
DRUG METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

THERAPEUTIC AGENTS

REMARKS:

J. O'NEIL IS ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

THE UPJOHN COMPANY  
301 HENRIETTA STREET  
KALAMAZOO, MICHIGAN 49001

H. WEBSTER (616)385-7439 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: LIGHT MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
DRUG METABOLISM  
LIPID METABOLISM  
PROTEIN METABOLISM  
VITAMIN METABOLISM  
LEVELS OF SERUM METALS AND ELECTRO-  
LYTES

TEST SYSTEMS UTILIZED:

RATS, DOGS, MICE, MONKEYS

COMPOUNDS TESTED:

PHARMACEUTICALS

REMARKS:

J. GRAY, R. PIPER, G. ELLIOTT, Y. YUAN, G. KOLAJA, AND  
D. STEVENS ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

D. SWENSEN (385-7352) IS INVOLVED WITH IN VITRO TECHNIQUES  
AT THIS ORGANIZATION BUT COULD NOT BE REACHED.

ORGANIZATION:

THOMAS JEFFERSON UNIVERSITY  
DEPARTMENT OF PHARMACOLOGY  
1020 LOCUST STREET  
PHILADELPHIA, PENNSYLVANIA 19107

C. WITMER (215)928-8963 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION  
RADIOISOTOPIC TECHNIQUES  
MEMBRANE INTEGRITY

BIOCHEMICAL TESTS: TISSUE ENZYME LEVELS  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, RABBITS, MICE, HAMSTERS

COMPOUNDS TESTED:

BENZENE,  $\text{CCl}_4$ , METALS, 4-NITROQUINOLINE OXIDE

REMARKS:

MUTAGENICITY TESTING IS A LARGE PART OF THE WORK DONE BY  
THIS GROUP.

R. SNYDER AND J. KOCSIS AND ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.

ORGANIZATION:

UNION CARBIDE CORPORATION  
BUSHY RUN RESEARCH CENTER  
RD 4 MELLON ROAD  
EXPORT, PENNSYLVANIA 15632

E. FOWLER (412)327-1020 (CONTACT)

TESTS PERFORMED:

HISTOPATHOLOGICAL TESTS: LIGHT MICROSCOPY  
MORPHOMETRIC ANALYSIS

FUNCTIONAL TESTS: DYE EXCRETION (ICG AND BSP)

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM  
(RADIO-LABELED METABOLITE  
CLEARANCE)  
LEVELS OF SERUM METALS  
AND ELECTROLYTES ( $\text{Na}^+$ ,  $\text{Cl}^-$ ,  $\text{K}^+$ )

TEST SYSTEMS UTILIZED:

RATS, MICE, DOGS

COMPOUNDS TESTED:

EXPERIMENTAL PESTICIDES, INDUSTRIAL INTERMEDIATES AND  
PRODUCTS (INFORMATION IS PROPRIETARY)

REMARKS:

E. HOMAN, R. YANG AND L. DEPASS ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.

ORGANIZATION:

UNIVERSITY OF ARIZONA  
ARIZONA HEALTH SCIENCE CENTER  
1501 N. CAMPBELL AVENUE  
TUSCON, ARIZONA 85724

G. SIPES (602)626-7123 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: LIGHT MICROSCOPY

FUNCTIONAL TESTS: MEMBRANE INTEGRITY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES  
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

ANESTHETICS, ALIPHATIC HALOGENATED HYDROCARBONS, NITROSAMINES,  
ETHIONINE

ORGANIZATION:

UNIVERSITY OF CALIFORNIA, IRVINE  
DEPARTMENT OF COMMUNITY AND ENVIRONMENTAL MEDICINE  
COLLEGE OF MEDICINE  
IRVINE, CALIFORNIA 92717

R. SHANK (714)833-5186 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS:	GROSS OBSERVATION LIGHT MICROSCOPY
FUNCTIONAL TESTS:	RADIOISOTOPIC TECHNIQUES
BIOCHEMICAL TESTS:	XENOBIOTIC METABOLISM DETOXIFICATION PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

RATS, MICE, HAMSTERS

COMPOUNDS TESTED:

HYDRAZINE COMPOUNDS, N-NITROSAMINES

REMARKS:

ALSO CONCERNED WITH DEVELOPMENTAL TESTS INVOLVING ABERRANT  
METHYLATION OF DNA AS RESULT OF CHEMICAL INSULT TO LIVER.

ORGANIZATION:

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO  
DEPARTMENT OF PATHOLOGY  
SAN FRANCISCO, CALIFORNIA 94143

E. SMUCKLER (415)666-5701 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM IN THE CYTO-  
CHROME P450 SYSTEM

TEST SYSTEMS UTILIZED:

MICE, RATS

COMPOUNDS TESTED:

POLYCHLORINATED HYDROCARBONS (CARBON TETRACHLORIDE,  
MONOBROMOTRICHLOROMETHANE, DIBROMOCHLOROPROPANE)

REMARKS:

G. CLAWSON, J. JAMES AND D. MOODY ARE ALSO INVOLVED IN  
HEPATOTOXICITY TESTING.



ORGANIZATION:

UNIVERSITY OF KANSAS MEDICAL CENTER  
DEPARTMENT OF MEDICINE AND PHARMACOLOGY  
KANSAS CITY, KANSAS 66103

C. DUJOVNE (913)588-7718 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: DYE EXCRETION TESTS (ROSE BENGAL  
AND INDOCYANINE GREEN)

BIOCHEMICAL TESTS: SERUM ENZYMES ( $\beta$ -GLUCURONIDASE,  
LDH\*, TRANSAMINASES)

IN VITRO TECHNIQUES: CULTURED HEPATOCYTES  
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

ISOLATED LIVER CELLS OR LIVER CELL CULTURES; RATS, RABBITS,  
MICE

COMPOUNDS TESTED:

GENERAL ANAESTHETICS (HALOTHANE, ETHER, CHLORPROMAZINE,  
PROMAZINE) ANTIDEPRESSANTS

REMARKS:

STUDIES ARE IN DRUG TRANSPORT AND UPTAKE USING ISOLATED  
LIVER CELLS OR LIVER CELL CULTURES.

---

\* Lactic dehydrogenase.

ORGANIZATION:

UNIVERSITY OF KANSAS MEDICAL CENTER  
DEPARTMENT OF CLINICAL PHARMACOLOGY AND TOXICOLOGY  
KANSAS CITY, KANSAS 66103

C. KLAASSEN (913) 588-7714 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM (LACTATE/PYRUVATE  
RATIO)  
PROTEIN METABOLISM (UREAGENESIS)  
XENOBIOTIC METABOLISM IN THE CYTOCHROME  
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

METALS (CADMIUM, ZINC, COPPER), AMINOPYRENE, CARBON  
TETRACHLORIDE, DIETHYLMALEATE, BROMOBENZENE, HEXABARBITOL

ORGANIZATION:

UNIVERSITY OF MICHIGAN  
SCHOOL OF PUBLIC HEALTH  
ANN ARBOR, MICHIGAN 48104

M. BRABEC (313)764-4399 (CONTACT)

TESTS PERFORMED:

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
PROTEIN METABOLISM (SYNTHESIS RATE)  
LIPID METABOLISM (PEROXIDATION)

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

HALOGENATED HYDROCARBONS (e.g., CARBON TETRACHLORIDE)  
UNSATURATED HYDROCARBONS (PROPYLENE, POLYBROMINATED BIPHENYL)

REMARKS:

R. CONOLLY, DEPARTMENT OF ENVIRONMENTAL AND INDUSTRIAL HEALTH,  
AND H. CORNISH ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

MECHANISMS OF HEPATIC TOXICITY ARE BEING STUDIED BUT TECHNIQUES  
COULD BE EASILY ADAPTED FOR A SCREENING PROTOCOL.

ORGANIZATION:

UNIVERSITY OF PITTSBURGH MEDICAL SCHOOL  
DEPARTMENT OF PATHOLOGY  
PITTSBURGH, PENNSYLVANIA 15261  
B. LOMBARDI (412)624-2941 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY  
HISTOCHEMISTRY

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYMES  
PROTEIN METABOLISM  
LIPID METABOLISM  
VITAMIN METABOLISM  
NUCLEIC ACID METABOLISM

TEST SYSTEMS UTILIZED:

SCREENING PROGRAM - RATS  
RESEARCH PROGRAM - MICE, RATS, RABBITS

COMPOUNDS TESTED:

CHEMICAL CARCINOGENS (e.g., AROMATIC HYDROCARBONS)

REMARKS:

CHEMICALS TESTED FOR EPA ARE ORGANIC CHEMICALS FOUND IN  
DRINKING WATER.

BASIC RESEARCH PROGRAM CONCERNS NUTRITIONAL EFFECTS ON  
LIVER AND PANCREATIC CANCER

ORGANIZATION:

UNIVERSITY OF PITTSBURGH MEDICAL SCHOOL  
DEPARTMENT OF PATHOLOGY  
PITTSBURGH, PENNSYLVANIA 15261

H. SHINOZUKA (412)624-2444 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

ORGANICS, KNOWN HEPATOTOXIC COMPOUNDS

ORGANIZATION:

UNIVERSITY OF SOUTHERN CALIFORNIA  
DEPARTMENT OF PHARMACOLOGY AND NUTRITION  
USC SCHOOL OF MEDICINE  
2025 ZONAL AVENUE  
LOS ANGELES, CALIFORNIA 90033

W. BIDLACK (213)224-7251 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION  
BILIRUBIN  
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
CARBOHYDRATE METABOLISM  
LIPID METABOLISM  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
DETOXIFICATION  
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES  
HEPATOMA CELLS  
ALTERATIONS OF MEMBRANE  
FUNCTIONS IN ISOLATED ORGANELLES  
(e.g., MICROSOMES, MITOCHONDRIA)

TEST SYSTEMS UTILIZED:

RATS, GUINEA PIGS

COMPOUNDS TESTED:

2-ACETYLAMINOFLUORENE, 2-ACETYL-1-HYDROXYAMINOFLUORINE, CARBON  
TETRACHLORIDE, ANILINE, p-NITROANISOLE, BENZO(A)PYRENE, NAPH-  
THALENE, DIMETHYLAMINOAZOBENZENE, AMINOPYRINE, ISONIAZID,  
CUMENE HYDROPEROXIDE (e.g., MICROSOMES, MITOCHONDRIA)

REMARKS:

P. HOPSTEIN AND A. COHEN ARE ALSO INVOLVED IN HEPATOTOXICITY  
TESTING.

ORGANIZATION:

UNIVERSITY OF TEXAS, AUSTIN  
COLLEGE OF PHARMACY  
AUSTIN, TEXAS 78712

D. ACOSTA (512)471-4736 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: HISTOCHEMICAL STAINING  
(LISSAMINE GREEN AND TRY PAN BLUE)

FUNCTIONAL TESTS: DYE EXCRETION TESTS (BSP)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS INCLUDING  
ARGININOSUCCINATE LYASE)  
CARBOHYDRATE METABOLISM (SUGAR RATIOS)  
PROTEIN METABOLISM (PROTEIN LEVELS,  
CHANGES IN ATP)  
NITROGEN METABOLISM (UREAGENESIS)  
XENOBIOTIC METABOLISM IN THE  
CYTOCHROME P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

ALCOHOL, CARBON TETRACHLORIDE, CAFFEINE, SODIUM SALICYLATE,  
THERAPEUTIC AGENTS: ACETAMINOPHEN, PAPAVERINE, TETRACYCLINE,  
NORETHRINDRONE, NITROFURANTOIN

REMARKS:

THESE IN VITRO METHODS ARE BEING COMPARED WITH THE RESULTS  
OF ANIMAL TOXICITY SCREENING STUDIES BY J. BRUCKNER AT THE  
UNIVERSITY OF TEXAS.

ORGANIZATION:

UNIVERSITY OF TEXAS MEDICAL SCHOOL  
DEPARTMENT OF PHARMACOLOGY  
HOUSTON, TEXAS 77025

J. BRUCKNER (713) 792-5977 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
PROTEIN METABOLISM  
GLYCOGEN SYNTHESIS, LEVELS OF ATP,  
UREAGENESIS  
XENOBIOTIC METABOLISM IN THE CYTOCHROME  
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

CHLORINATED HYDROCARBONS (i.e., DDT, PCBs)

REMARKS:

THESE IN VIVO METHODS ARE BEING CORRELATED WITH D. ACOSTA'S  
IN VITRO SCREENING TESTS USING PRIMARY HEPATOCYTES AT THE  
UNIVERSITY OF TEXAS, AUSTIN. ONE OF THE GOALS IS TO BE ABLE  
TO REACH THE SAME RANK ORDER OF TOXICITY OF THE COMPOUNDS  
TESTED.



ORGANIZATION:

UNIVERSITY OF TEXAS (UTMB)  
DEPARTMENT OF PATHOLOGY  
GALVESTON, TEXAS 77550

E. REYNOLDS (713)765-2889 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND  
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY  
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS  
PROTEIN METABOLISM  
XENOBIOTIC METABOLISM  
VITAMIN METABOLISM  
LEVELS OF LIVER METALS AND SERUM  
ELECTROLYTES  
DETOXIFICATION  
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

KNOWN HEPATOTOXINS

REMARKS:

PRINCIPAL INTEREST IN INVESTIGATING MOLECULAR MECHANISMS OF  
CELLULAR INJURY.

ORGANIZATION:

UNIVERSITY OF TORONTO  
DEPARTMENT OF PATHOLOGY  
TORONTO, ONTARIO, CANADA

E. FARBER (416)978-2557 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION  
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (TRANSAMINASES AND  
LACTIC DEHYDROGENASE  
XENOBIOTIC METABOLISM IN THE CYTOCHROME  
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED.

REMARKS:

MOSTLY INVOLVED IN BASIC CANCER INITIATION RESEARCH;  
NEVERTHELESS, A FEW SCREENING TECHNIQUES ARE EMPLOYED.

ORGANIZATION:

UNIVERSITY OF WISCONSIN  
McCARDLE INSTITUTE  
MADISON, WISCONSIN 53705

H. PITOT (608)262-2177 (CONTACT)

TESTS PERFORMED:

MONITORING CARCINOGENIC MECHANISMS IN WHOLE ANIMAL TO  
DISTINGUISH BETWEEN COMPLETE CARCINOGENS, CARCINOGENIC  
ENHANCERS OR PROMOTERS BY TIMED DOSES

ALSO STUDYING DNA REPAIR IN PRIMARY HEPATOCYTES.

TEST SYSTEMS UTILIZED:

HAMSTERS, MICE, RATS

COMPOUNDS TESTED:

IN VITRO: KNOWN CARCINOGENS (i.e., BUTTER YELLOW)  
IN VIVO: PROMOTING (i.e., TCDD) OR INITIATING (i.e.,  
PROFLAVIN) AGENTS

REMARKS:

A. SINICA, DEPARTMENT OF ANATOMY, IS WORKING ON DNA REPAIR  
AT THIS ORGANIZATION.

ORGANIZATION:

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY  
ABERDEEN PROVING GROUNDS, MARYLAND 21010

A. McCREESH (302)671-3627 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUE (CLEARANCE AFTER  
DERMAL EXPOSURE)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (SGOT, SGPT, ALP,  
LDH, ETC.)  
PROTEIN METABOLISM (NITRITES, NITRATES)  
LEVELS OF SERUM ELECTROLYTES AND METALS  
(Na<sup>+</sup>, Ca<sup>+</sup>, K<sup>+</sup>)  
DETOXIFICATION  
PRODUCT SYNTHESIS (BLOOD METABOLISM)

TEST SYSTEMS UTILIZED:

DOGS, GUINEA PIGS, RABBITS, RATS

COMPOUNDS TESTED:

PROPELLANTS, EXPLOSIVES, PESTICIDES, FUNGICIDES AND  
DISINFECTANTS.

ORGANIZATION:

VANDERBILT UNIVERSITY  
DEPARTMENT OF BIOCHEMISTRY  
NASHVILLE, TENNESSEE 37232

R. A. NEAL (615)322-2261 (CONTACT)

TEST PERFORMED:

BASIC RESEARCH: MECHANISMS OF HEPATOTOXICITY.

NOT STUDYING SCREENING TESTS OR METHODS.

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

SULFUR-CONTAINING COMPOUNDS

APPENDIX A  
TESTS PERFORMED BY EACH ORGANIZATION

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Duke Medical Center  
Exxon Corporation  
Food Research Institute  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto  
U.S. Army Environmental Hygiene Agency

### FUNCTIONAL TESTS

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynaics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
Food Research Institute  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMO NJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of Kansas Medical Center  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

### DYE EXCRETION (BSP, ICG, ETC.)

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories



FUNCTIONAL TESTS (Continued)

Hoffman LaRoche Incorporated  
Litton Bionetics Incorporated  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Temple University School of Medicine  
Thomas Jefferson University  
Union Carbide Corporation  
University of Kansas Medical Center  
University of Southern California  
University of Texas, Austin

BILIRUBIN (SERUM URINE,  
UROBILINOGEN LEVELS:  
BILIARY TRANSPORT MAXIMUM)

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
University of Southern California

FUNCTIONAL TESTS (Continued)

RADIOISOTOPIC TECHNIQUES

Albert Einstein College of Medicine  
Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
Thomas Jefferson University  
University of California, Irvine  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

MEMBRANE INTEGRITY

Food Research Institute  
Thomas Jefferson University  
University of Arizona

## BIOCHEMICAL TESTS

Abbott Laboratories  
Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Duke Medical Center  
Exxon Corporation  
Food and Drug Research Laboratories  
Food Research Institute  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Kansas Medical Center  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto  
U.S. Army Environmental Hygiene Agency

BIOCHEMICAL TESTS (Continued)

SERUM ENZYME LEVELS  
(SCOT, SCPT, ALP, ETC.)

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
University of Arizona  
University of Kansas Medical Center  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto  
U.S. Army Environmental Hygiene Agency

CARBOHYDRATE METABOLISM  
(e.g. GLUCOSE LEVELS)

Abbott Laboratories  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated

BIOCHEMICAL TESTS (Continued)

International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
University of Kansas Medical Center  
University of Southern California  
University of Texas, Austin

LIPID METABOLISM (PLASMA  
OR SERUM CHOLESTEROL LEVELS)

Abbott Laboratories  
Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Temple University  
The Upjohn Company  
University of Michigan  
University of Pittsburgh Medical School

PROTEIN METABOLISM (BUN UREAGENESIS,  
SERUM PROTEIN LEVELS, i.e., ALBUMIN  
GLOBULIN LEVELS, ELECTROPHORESIS)

Abbott Laboratories  
Albert Einstein College of Medicine

### BIOCHEMICAL TESTS (Continued)

#### Bio-Dynamics

Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
Thomas Jefferson University  
University of Arizona  
University of Kansas Medical Center  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

#### NITROGEN METABOLISM (UREAGENESIS)

Dow Chemical USA  
Hoffman LaRoche Incorporated  
University of Texas, Austin

#### XENOBIOTIC METABOLISM

Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Duke Medical Center  
Food Research Institute  
G.D. Searle and Company  
George Washington University Hospital  
Litton Bionetics Incorporated

### BIOCHEMICAL TESTS (Continued)

Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University  
Temple University School of Medicine  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Kansas Medical Center  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto

#### DRUG METABOLISM

Food Research Institute  
Massachusetts Institute of Technology  
Midwest Research Institute  
Temple University School of Medicine  
The Upjohn Company

#### VITAMIN METABOLISM

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
University of Pittsburgh Medical School  
University of Texas (UTMB)

#### LEVELS OF SERUM METALS AND ELECTROLYTES (HEAVY METALS, NA, K, CL<sup>-</sup>)

Abbott Laboratories

### BIOCHEMICAL TESTS (Continued)

Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Union Carbide Corporation  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

#### LEVELS OF TISSUE LIVER METALS

Massachusetts Institute of Technology

#### VITAMIN ASSAYS

Massachusetts Institute of Technology

#### TISSUE ENZYME LEVELS

Massachusetts Institute of Technology  
Thomas Jefferson University

#### DETOXIFICATION AND PRODUCT SYNTHESIS

Bio-Dynamics  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Sterling Winthrop Research Institute



### IN VITRO TECHNIQUES

Albert Einstein College of Medicine  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Food Research Institute  
George Washington University Hospital  
Medical College of Virginia  
Midwest Research Institute  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Thomas Jefferson University  
University of Arizona  
University of Kansas Medical Center  
University of Southern California  
University of Texas (UTMB)

#### PERFUSED LIVER

Albert Einstein College of Medicine  
George Washington University Hospital

#### HEPATOCYTES

Albert Einstein College of Medicine  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Food Research Institute  
George Washington University Hospital  
Medical College of Virginia  
Midwest Research Institute  
Thomas Jefferson University  
University of Arizona  
University of Kansas Medical Center  
University of Southern California  
University of Texas (UTMB)

#### HEPATOMA CELLS

Albert Einstein College of Medicine  
Food Research Institute  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)

IN VITRO TECHNIQUES (Continued)

University of Arizona  
University of Kansas Medical Center  
University of Southern California

MEMBRANE INTEGRITY

Albert Einstein College of Medicine

CELL NECROSIS

Naylor Dana Institute

DNA DAMAGE

Chemical Industry Institute of Toxicology  
Naylor Dana Institute

MUTAGENESIS

Naylor Dana Institute

ALTERATIONS OF MEMBRANE FUNCTIONS IN ISOLATED ORGANELLES

University of Southern California

APPENDIX B

TEST SYSTEMS UTILIZED BY EACH ORGANIZATION

CATS

Food and Drug Research Laboratories

FUNCTIONAL TESTS

Dye Excretion

Food and Drug Research Laboratories

Bilirubin

Food and Drug Research Laboratories

BIOCHEMICAL TESTS

Serum Enzyme Levels

Food and Drug Research Laboratories

Carbohydrate Metabolism

Food and Drug Research Laboratories

Lipid Metabolism

Food and Drug Research Laboratories

Protein Metabolism

Food and Drug Research Laboratories

Vitamin Metabolism

Food and Drug Research Laboratories

Levels of Serum Metals and Electrolytes

Food and Drug Research Laboratories

Detoxification and Synthesis

Food and Drug Research Laboratories

CHICKENS

International Research and Development Corporation

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

International Research and Development Corporation

FUNCTIONAL TESTS

Bilirubin

International Research and Development Corporation

BIOCHEMICAL TESTS

Serum Enzyme Levels

International Research and Development Corporation

Carbohydrate Metabolism

International Research and Development Corporation

Lipid Metabolism

International Research and Development Corporation

Protein Metabolism

International Research and Development Corporation

Vitamin Metabolism

International Research and Development Corporation

Levels of Serum Metals and Electrolytes

International Research and Development Corporation

Detoxification and Synthesis

International Research and Development Corporation

## DOGS

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company  
Union Carbide Corporation  
University of California  
U.S. Army Environmental Hygiene Agency

## MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company  
Union Carbide Corporation  
U.S. Army Environmental Hygiene Agency

DOGS (Continued)

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
Litton Bionetics Incorporated  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Union Carbide Corporation

Bilirubin

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company

Radioisotopic Techniques

Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Science

DOGS (Continued)

FUNCTIONAL TESTS (Continued)

Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
U.S. Army Environmental Hygiene Agency

BIOCHEMICAL TESTS

Serum Enzyme Levels

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company  
University of California  
U.S. Army Environmental Hygiene Agency

Carbohydrate Metabolism

Abbott Laboratories  
Bio-Dynamics  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Lipid Metabolism

Abbott Laboratories  
Bio-Dynamics



DOGS (Continued)

BIOCHEMICAL TESTS (Continued)

Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Protein Metabolism

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Dow Chemical USA  
Hoffman LaRoche Incorporated

DOGS (Continued)

BIOCHEMICAL TESTS (Continued)

Xenobiotic Metabolism

Dow Chemical USA  
G.D. Searle and Company  
Litton Bionetics Incorporated  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Union Carbide Corporation

Drug Metabolism

Massachusetts Institute of Technology  
Midwest Research Institute  
The Upjohn Company

Vitamin Metabolism

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Levels of Serum Metals and Electrolytes

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute  
The Upjohn Company  
Union Carbide Corporation  
U.S. Army Environmental Hygiene Agency

DOGS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology

Detoxification and Product Synthesis

Bio-Dynamics

Exxon Corporation

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Monsanto Company

National Institute of Environmental Health Sciences

Sterling Winthrop Research Institute

U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Hepatocytes

Dow Chemical USA

Midwest Research Institute

Hepatoma Cells

Midwest Research Institute

Rutgers Medical School (CMDNJ)

FISH

Albert Einstein College of Medicine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine

FUNCTIONAL TESTS

Dye Excretion

Albert Einstein College of Medicine

Bilirubin

Albert Einstein College of Medicine

Radioisotopic Techniques

Albert Einstein College of Medicine

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine

Lipid Metabolism

Albert Einstein College of Medicine

Protein Metabolism

Albert Einstein College of Medicine

Xenobiotic Metabolism

Albert Einstein College of Medicine

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

FISH (Concluded)

IN VITRO TECHNIQUES (Concluded)

Hepatocytes and Hepatoma Cells

Albert Einstein College of Medicine

Membrane Integrity

Albert Einstein College of Medicine

GOATS

Albert Einstein College of Medicine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine

FUNCTIONAL TESTS

Dye Excretion

Albert Einstein College of Medicine

Bilirubin

Albert Einstein College of Medicine

Radioisotopic Techniques

Albert Einstein College of Medicine

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine

Lipid Metabolism

Albert Einstein College of Medicine

Protein Metabolism

Albert Einstein College of Medicine

GOATS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Xenobiotic Metabolism

Albert Einstein College of Medicine

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes and Hepatoma Cells

Albert Einstein College of Medicine

Membrane Integrity

Albert Einstein College of Medicine

GUINEA PIGS

Bio-Dynamics

Food and Drug Research Laboratories

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Sterling Winthrop Research Institute

University of Southern California

U.S. Army Environmental Hygiene Agency

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Bio-Dynamics

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Sterling Winthrop Research Institute

University of Southern California

U.S. Army Environmental Hygiene Agency

GUINEA PIGS (Continued)

FUNCTIONAL TESTS

Dye Excretion

Bio-Dynamics  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
Midwest Research Institute  
University of Southern California

Bilirubin

Bio-Dynamics  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Sterling Winthrop Research Institute  
University of Southern California

Radiosotopic Techniques

Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
University of Southern California  
U.S. Army Environmental Hygiene Agency

BIOCHEMICAL TESTS

Serum Enzyme Levels

Bio-Dynamics  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Sterling Winthrop Research Institute  
University of Southern California  
U.S. Army Environmental Hygiene Agency

GUINEA PIGS (Continued)

BIOCHEMICAL TESTS (Continued)

Carbohydrate Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
University of Southern California

Lipid Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
University of Southern California

Protein Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
University of Southern California  
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Bio-Dynamics  
Midwest Research Institute  
University of Southern California



GUINEA PIGS (Continued)

BIOCHEMICAL TESTS (Continued)

Drug Metabolism

Massachusetts Institute of Technology  
Midwest Research Institute

Vitamin Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute

Levels of Serum Metals and Electrolytes

Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Sterling Winthrop Research Institute

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Alterations of Membrane Functions in Isolated Organelles

University of Southern California

Tissue Enzyme Levels

Massachusetts Institute of Technology

Detoxification and Product Synthesis

Bio-Dynamics  
Food and Drug Research Laboratories

## GUINEA PIGS (Concluded)

### BIOCHEMICAL TESTS (Concluded)

Hazleton Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
University of Southern California  
U.S. Army Environmental Hygiene Agency

### IN VITRO TECHNIQUES

#### Hepatocytes

Midwest Research Institute  
University of Southern California

#### Hepatoma Cells

Midwest Research Institute  
University of Southern California

## HAMSTERS

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Naylor Dana Institute  
Sterling Winthrop Research Institute  
Thomas Jefferson University  
University of California, Irvine

### MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Bio-Dynamics  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Naylor Dana Institute  
Sterling Winthrop Research Institute  
Thomas Jefferson University  
University of California, Irvine

## HAMSTERS (Continued)

### FUNCTIONAL TESTS (Concluded)

#### Dye Excretion

Bio-Dynamics  
Food and Drug Research Laboratories  
Midwest Research Institute  
Monsanto Company  
Thomas Jefferson University

#### Bilirubin

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute

#### Radioisotopic Techniques

Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Thomas Jefferson University  
University of California, Irvine

#### Membrane Integrity

Thomas Jefferson University

### BIOCHEMICAL TESTS

#### Serum Enzyme Levels

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute

HAMSTERS (Continued)

BIOCHEMICAL TESTS (Continued)

Carbohydrate Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Midwest Research Institute  
Monsanto Company

Lipid Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company

Protein Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research Institute  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Thomas Jefferson University

Xenobiotic Metabolism

Bio-Dynamics  
Midwest Research Institute  
Naylor Dana Institute  
Thomas Jefferson University  
University of California, Irvine

Drug Metabolism

Massachusetts Institute of Technology  
Midwest Research Institute

HAMSTERS (Continued)

BIOCHEMICAL TESTS (Concluded)

Vitamin Metabolism

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Midwest Research Institute

Levels of Serum Metals and Electrolytes

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology  
Thomas Jefferson University

Detoxification and Product Synthesis

Bio-Dynamics  
Food and Drug Research Laboratories  
International Research and Development Institute  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Naylor Dana Institute  
Thomas Jefferson University  
University of California, Irvine

HAMPSTERS (Concluded)

IN VITRO TECHNIQUES

Hepatocytes

Midwest Research Institute  
Thomas Jefferson University

Hepatoma Cells

Midwest Research Institute

Cell Necrosis

Naylor Dana Institute

DNA Damage

Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

HUMANS

Duke Medical Center  
Food and Drug Research Laboratories  
Sterling Winthrop Research Institute

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Duke Medical Center

FUNCTIONAL TESTS

Dye Excretion

Food and Drug Research Laboratories

Bilirubin

Food and Drug Research Laboratories

Radioisotopic Techniques

Sterling Winthrop Research Institute

HUMANS (Concluded)

BIOCHEMICAL TESTS

Serum Enzyme Levels

Food and Drug Research Laboratories

Carbohydrate Metabolism

Food and Drug Research Laboratories

Lipid Metabolism

Food and Drug Research Laboratories

Protein Metabolism

Food and Drug Research Laboratories

Xenobiotic Metabolism

Duke Medical Center  
Sterling Winthrop Research Institute

Vitamin Metabolism

Food and Drug Research Laboratories

Levels of Serum Metals and Electrolytes

Food and Drug Research Laboratories

Detoxification and Product Synthesis

Food and Drug Research Laboratories  
Sterling Winthrop Research Institute

IN VITRO TECHNIQUES

DNA Damage

Duke Medical Center

## MICE

Abbott Laboratories  
Albert Einstein College of Medicine  
American Health Foundation  
Baylor College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Kansas Medical Center  
University of Pittsburgh Medical School  
University of Texas (UTMB)

## MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)



MICE (Continued)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS (Concluded)

Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
University of Arizona  
University of California, Irvine  
Union Carbide Corporation  
University of California, San Francisco  
University of Pittsburgh Medical School  
University of Texas (UTMB)

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
Litton Bionetics Incorporated  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
Temple University School of Medicine  
Thomas Jefferson University  
Union Carbide Corporation  
University of Kansas Medical Center

Bilirubin

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories

AD-A104 763

MITRE CORP MCLEAN VA METREK DIV  
EVALUATION OF SHORT-TERM BIOASSAYS TO PREDICT FUNCTIONAL IMPAIR--ETC(U)  
OCT 80 P GREENAWAY, J KONZ, R THOMAS  
DAMD17-76-C-8068

F/8 6/20

UNCLASSIFIED

WP-79W00223

NL

2 of 2  
A7-34 7e-3


END  
DATE  
FILMED  
10-81  
DTIC

MICE (Continued)

FUNCTIONAL TESTS (Concluded)

Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company

Radioisotopic Techniques

Albert Einstein College of Medicine  
Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Temple University School of Medicine  
Thomas Jefferson University  
University of California, Irvine  
University of Pittsburgh Medical School  
University of Texas (UTMB)

Membrane Integrity

Thomas Jefferson University  
University of Arizona

BIOCHEMICAL TESTS

Serum Enzyme Levels

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute

MICE (Continued)

BIOCHEMICAL TESTS (Continued)

Temple University School of Medicine  
The Upjohn Company  
University of Arizona  
University of Kansas Medical Center  
University of Pittsburgh Medical School  
University of Texas (UTMB)

Carbohydrate Metabolism

Abbott Laboratories  
Bio-Dynamics  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Lipid Metabolism

Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
University of Pittsburgh Medical School

MICE (Continued)

BIOCHEMICAL TESTS (Continued)

Protein Metabolism

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
Thomas Jefferson University  
University of Arizona  
University of Pittsburgh Medical School  
University of Texas (UTMB)

Nitrogen Metabolism

Dow Chemical  
Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
G.D. Searle and Company  
Litton Bionetics Incorporated  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Temple University School of Medicine  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine

MICE (Continued)

BIOCHEMICAL TESTS (Continued)

University of California, San Francisco  
University of Texas (UTMB)

Drug Metabolism

Massachusetts Institute of Technology  
Midwest Research Institute  
Temple University School of Medicine  
The Upjohn Company

Vitamin Metabolism

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
University of Pittsburgh Medical School  
University of Texas (UTMB)

Levels of Serum Metals and Electrolytes

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Union Carbide Corporation  
University of Texas (UTMB)

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

MICE (Continued)

BIOCHEMICAL TESTS (Concluded)

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology  
Thomas Jefferson University

Detoxification and Product Synthesis

Bio-Dynamics  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Temple University School of Medicine  
Thomas Jefferson University  
University of Arizona  
University of California, Irvine  
University of Texas (UTMB)

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes

Albert Einstein College of Medicine  
Dow Chemical USA  
Midwest Research Institute  
Thomas Jefferson University  
University of Arizona  
University of Kansas Medical Center  
University of Texas (UTMB)

MICE (Concluded)

IN VITRO TECHNIQUES (Concluded)

Hepatoma Cells

Albert Einstein College of Medicine  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
University of Arizona  
University of Kansas Medical Center

Membrane Integrity

Albert Einstein College of Medicine

Cell Necrosis

Naylor Dana Institute

DNA Damage

Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

MONKEYS

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company



MONKEYS (Continued)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
Litton Bionetics Incorporated  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)

Bilirubin

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
The Upjohn Company

MONKEYS(Continued)

BIOCHEMICAL TESTS (Continued)

Dow Chemical USA  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Protein Metabolism

Abbott Laboratories  
Bio-Dynamics  
Dow Chemical USA  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Nitrogen Metabolism

Dow Chemical USA  
Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Bio-Dynamics  
Dow Chemical USA  
G.D. Searle and Company  
Litton Bionetics Incorporated  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute

MONKEYS (Continued)

FUNCTIONAL TESTS (Concluded)

Radioisotopic Techniques

Bio-Dynamics

Massachusetts Institute of Technology

Midwest Research Institute

Rutgers Medical School (CMDNJ)

Sterling Winthrop Research Institute

BIOCHEMICAL TESTS

Serum Enzyme Levels

Abbott Laboratories

Bio-Dynamics

Dow Chemical USA

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Litton Bionetics Incorporated

Midwest Research Institute

Rutgers Medical School (CMDNJ)

Sterling Winthrop Research Institute

The Upjohn Company

Carbohydrate Metabolism

Abbott Laboratories

Bio-Dynamics

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Litton Bionetics Incorporated

Midwest Research Institute

Rutgers Medical School (CMDNJ)

The Upjohn Company

Lipid Metabolism

Abbott Laboratories

Bio-Dynamics

MONKEYS (Continued)

BIOCHEMICAL TESTS (Continued)

Drug Metabolism

Massachusetts Institute of Technology  
Midwest Research Institute  
The Upjohn Company

Vitamin Metabolism

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company

Levels of Serum Metals and Electrolytes

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
Massachusetts Institute of Technology  
Midwest Research Institute  
Sterling Winthrop Research Institute  
The Upjohn Company

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology

MONKEYS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Detoxification and Product Synthesis

Bio-Dynamics  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Sterling Winthrop Research Institute

IN VITRO TECHNIQUES

Hepatocytes

Dow Chemical USA  
Midwest Research Institute

Hepatoma Cells

Midwest Research Institute  
Rutgers Medical School

PIGS

Food and Drug Research Laboratories  
International Research and Development Corporation

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

International Research and Development Corporation

FUNCTIONAL TESTS

Dye Excretion

Food and Drug Research Laboratories

Bilirubin

Food and Drug Research Laboratories  
International Research and Development Corporation

PIGS (Concluded)

BIOCHEMICAL TESTS

Serum Enzyme Levels

Food and Drug Research Laboratories  
International Research and Development Corporation

Carbohydrate Metabolism

Food and Drug Research Laboratories  
International Research and Development Corporation

Lipid Metabolism

Food and Drug Research Laboratories  
International Research and Development Corporation

Protein Metabolism

Food and Drug Research Laboratories  
International Research and Development Corporation

Levels of Serum Metals and Electrolytes

Food and Drug Research Laboratories  
International Research and Development Corporation

Detoxification and Product Synthesis

Food and Drug Research Laboratories  
International Research and Development Corporation

Vitamin Metabolism

Food and Drug Research Laboratories  
International Research and Development Corporation

RABBITS

Albert Einstein College of Medicine  
American Health Foundation  
Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation

## RABBITS (Continued)

Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Thomas Jefferson University  
University of Kansas Medical Center  
University of Pittsburgh Medical School  
U.S. Army Environmental Hygiene Agency

### MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine  
Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Thomas Jefferson University  
University of Pittsburgh Medical School  
U.S. Army Environmental Hygiene Agency

### FUNCTIONAL TESTS

#### Dye Excretion

Albert Einstein College of Medicine  
Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Thomas Jefferson University  
University of Kansas Medical Center

RABBITS (Continued)

FUNCTIONAL TESTS (Concluded)

Bilirubin

Albert Einstein College of Medicine  
Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute

Radioisotopic Techniques

Albert Einstein College of Medicine  
Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Thomas Jefferson University  
University of Pittsburgh Medical School  
U.S. Army Environmental Hygiene Agency

Membrane Integrity

Thomas Jefferson University

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine  
Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute



RABBITS (Continued)

BIOCHEMICAL TESTS (Continued)

University of Kansas Medical Center  
University of Pittsburgh Medical School  
U.S. Army Environmental Hygiene Agency

Carbohydrate Metabolism

Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)

Lipid Metabolism

Albert Einstein College of Medicine  
Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
University of Pittsburgh Medical School

Protein Metabolism

Albert Einstein College of Medicine  
Bio-Dynamics  
Exxon Corporation  
Food and Drug Research Laboratories  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Thomas Jefferson University

RABBITS (Continued)

BIOCHEMICAL TESTS (Continued)

University of Pittsburgh Medical School  
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Albert Einstein College of Medicine  
Midwest Research Institute  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Thomas Jefferson University

Drug Metabolism

Massachusetts Institute of Technology  
Midwest Research Institute

Vitamin Metabolism

Bio-Dynamics  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
University of Pittsburgh Medical School

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine  
Bio-Dynamics  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute  
U.S. Army Environmental Hygiene Agency

RABBITS (Continued)

BIOCHEMICAL TESTS (Concluded)

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

International Research and Development Corporation  
Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology  
Thomas Jefferson University

Detoxification and Synthesis

Bio-Dynamics  
Exxon Corporation  
Hazleton Laboratories  
International Research and Development Corporation  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Naylor Dana Institute  
Thomas Jefferson University  
U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes

Albert Einstein College of Medicine  
Midwest Research Institute  
Thomas Jefferson University  
University of Kansas Medical Center

Hepatoma Cells

Albert Einstein College of Medicine  
Midwest Research Institute

RABBITS (Concluded)

IN VITRO TECHNIQUES (Concluded)

Rutgers Medical School (CMDNJ)  
University of Kansas Medical Center

Membrane Integrity

Albert Einstein College of Medicine

Cell Necrosis

Naylor Dana Institute

DNA Damage

Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

RATS

Abbott Laboratories  
Albert Einstein College of Medicine  
American Health Foundation  
Baylor College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Duke Medical Center  
Exxon Corporation  
Food and Drug Research Laboratories  
Food Research Institute  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Medical College of Virginia  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences

RATS (Continued)

Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Kansas Medical Center  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto  
U.S. Army Environmental Hygiene Agency

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Duke Medical Center  
Exxon Corporation  
Food Research Institute  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Medical College of Virginia  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University

RATS (Continued)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Kansas Medical Center  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto  
U.S. Army Environmental Hygiene Agency

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
Litton Bionetics Incorporated  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Temple University School of Medicine  
The Upjohn Company  
Thomas Jefferson University  
Union Carbide Corporation  
University of Kansas Medical Center  
University of Southern California  
University of Texas, Austin

RATS (Continued)

FUNCTIONAL TESTS (Continued)

Bilirubin

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
University of Southern California

Radioisotopic Techniques

Albert Einstein College of Medicine  
Bio-Dynamics  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
Thomas Jefferson University  
University of California, Irvine  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Membrane Integrity

Food Research Institute  
Thomas Jefferson University  
University of Arizona

Serum Enzyme Levels

Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
George Washington University Hospital  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
University of Arizona  
University of Kansas Medical Center  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas (UTMB)  
University of Texas Medical School  
University of Toronto  
U.S. Army Environmental Hygiene Agency



RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Carbohydrate Metabolism

Abbott Laboratories  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
University of Kansas Medical Center  
University of Southern California  
University of Texas, Austin

Lipid Metabolism

Abbott Laboratories  
Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Temple University  
The Upjohn Company  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California

Protein Metabolism

Abbott Laboratories  
Albert Einstein College of Medicine  
Baylor College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology  
Dow Chemical USA  
Exxon Corporation  
Food and Drug Research Laboratories  
G.D. Searle and Company  
Hazleton Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Medical College of Virginia  
Midwest Research Institute  
Monsanto Company  
National Institute of Environmental Health Sciences  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
Thomas Jefferson University  
University of Arizona  
University of Kansas Medical Center  
University of Michigan  
University of Pittsburgh Medical School  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Dow Chemical USA  
Hoffman LaRoche Incorporated  
University of Texas, Austin

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Xenobiotic Metabolism

Albert Einstein College of Medicine  
Baylor College of Medicine  
Dow Chemical USA  
Duke Medical Center  
Food Research Institute  
G.D. Searle and Company  
George Washington University Hosptial  
Litton Bionetics Incorporated  
Medical College of Virginia  
Midwest Research Institute  
National Institute of Environmental Health Sciences  
Naylor Dana Institute  
Rutgers Medical School (CMDNJ)  
Sterling Winthrop Research Institute  
Temple University  
Temple Unviersity School of Medicine  
Thomas Jefferson University  
Union Carbide Corporation  
University of Arizona  
University of California, Irvine  
University of California, San Francisco  
University of Kansas Medical Center  
University of Southern California  
University of Texas, Austin  
University of Texas Medical School  
University of Texas (UTMB)  
University of Toronto

Drug Metabolism

Food Research Institute  
Massachusetts Institute of Technology  
Midwest Research Institute  
Temple University School of Medicine  
The Upjohn Company

Levels of Serum Metals and Electrolytes

Abbott Laboratories  
Albert Einstein College of Medicine  
Bio-Dynamics  
Chemical Industry Institute of Toxicology

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Food and Drug Research Laboratories  
G.D. Searle and Company  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Litton Bionetics Incorporated  
3M-Riker Laboratories  
Massachusetts Institute of Technology  
Midwest Research Institute  
Monsanto Company  
Sterling Winthrop Research Institute  
Temple University School of Medicine  
The Upjohn Company  
Union Carbide Corporation  
University of Texas (UTMB)  
U.S. Army Environmental Hygiene Agency

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Vitamin Metabolism

Abbott Laboratories  
Bio-Dynamics  
Food and Drug Research Laboratories  
Hoffman LaRoche Incorporated  
International Research and Development Corporation  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
The Upjohn Company  
University of Pittsburgh Medical School  
University of Texas (UTMB)

Tissue Enzyme Levels

Massachusetts Institute of Technology  
Thomas Jefferson University

RATS (Continued)

BIOCHEMICAL TESTS (Concluded)

Detoxification and Product Synthesis

Bio-Dynamics

Exxon Corporation

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Monsanto Company

National Institute of Environmental Health Sciences

Naylor Dana Institute

Sterling Winthrop Research Institute

Temple University School of Medicine

Thomas Jefferson University

University of Arizona

University of California, Irvine

University of Southern California

University of Texas (UTMB)

U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

George Washington University Hospital

Hepatocytes

Albert Einstein College of Medicine

Chemical Industry Institute of Toxicology

Dow Chemical USA

Food Research Institute

George Washington University Hospital

Medical College of Virginia

Midwest Research Institute

Thomas Jefferson University

University of Arizona

University of Kansas Medical Center

University of Southern California

University of Texas (UTMB)

RATS (Concluded)

IN VITRO TECHNIQUES (Concluded)

Hepatoma Cells

Albert Einstein College of Medicine  
Food Research Institute  
Midwest Research Institute  
Rutgers Medical School (CMDNJ)  
University of Arizona  
University of Kansas Medical Center  
University of Southern California

Membrane Integrity

Albert Einstein College of Medicine

Cell Necrosis

Naylor Dana Institute

DNA Damage

Chemical Industry Institute of Toxicology  
Duke Medical Center  
Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

Alterations of Membrane Functions in Isolated Organelles

University of Southern California

SHEEP

Albert Einstein College of Medicine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine

FUNCTIONAL TESTS

Dye Excretion

Albert Einstein College of Medicine

SHEEP (Continued)

FUNCTIONAL TESTS (Concluded)

Bilirubin

Albert Einstein College of Medicine

Radioisotopic Techniques

Albert Einstein College of Medicine

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine

Lipid Metabolism

Albert Einstein College of Medicine

Protein Metabolism

Albert Einstein College of Medicine

Xenobiotic Metabolism

Albert Einstein College of Medicine

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes

Albert Einstein College of Medicine

Hepatoma Cells

Albert Einstein College of Medicine

Membrane Integrity

Albert Einstein College of Medicine

APPENDIX C  
INDEX OF INDIVIDUALS IN THE DIRECTORY



<u>NAME</u>	<u>ORGANIZATION</u>
Abernathy, C.	George Washington University Hospital
Acosta, D.	University of Texas, Austin
Arias, I.	Albert Einstein College of Medicine
Barnhart, B.	Midwest Research Institute
Becci, P.	Food and Drug Research Laboratories
Bermudez, E.	Chemical Industry Institute of Toxicology
Bidlack, W.	University of Southern California
Black, M.	Temple University School of Medicine
Bond, J.	Chemical Industry Institute of Toxicology
Brabec, M.	University of Michigan
Bruckner, J.	University of Texas Medical School
Butterworth, B.	Chemical Industry Institute of Toxicology
Case, M.	3M-Riker Laboratories
Chabra, R.	National Institute of Environmental Health Sciences
Cholakis, J.	Midwest Research Institute
Chowdhury, R.	Albert Einstein College of Medicine
Clawson, G.	University of California, San Francisco
Cochran, G.	Baylor College of Medicine
Cohen, A.	University of Southern California
Conney, A.	Hoffman LaRoche Incorporated
Conolly, R.	University of Michigan
Cornish, H.	University of Michigan
Cox, G.	Food and Drug Research Laboratories

<u>NAME</u>	<u>ORGANIZATION</u>
DePass, L.	Union Carbide Corporation
Dodd, D.	G.D. Searle and Company
Drobeck, H.P.	Sterling Winthrop Research Institute
Dujovne, C.	University of Kansas Medical Center
Edelson, J.	Sterling Winthrop Research Institute
Egan, G.F.	Exxon Corporation
El-Hawari, M.	Midwest Research Institute
Elliott, G.	The Upjohn Company
Ellis, H.	Midwest Research Institute
Fallon, H.F.	Medical College of Virginia
Farber, E.	University of Toronto
Farber, J.L.	Temple University
Feinman, H.	Food and Drug Research Laboratories
Folk, R.	Monsanto Company
Fowler, E.	Union Carbide Corporation
Gehring, P.	Dow Chemical, USA
Gibson, J.	Chemical Industry Institute of Toxicology
Giss, H.	Litton Bionetics Incorporated
Goldenthal, E.	International Research and Development Corporation
Goldman, D.	Medical College of Virginia
Goldstein, J.	National Institute of Environmental Health Sciences
Gralla, E.	Chemical Industry Institute of Toxicology
Gray, J.	The Upjohn Company
Guzelian, P.	Medical College of Virginia

<u>NAME</u>	<u>ORGANIZATION</u>
Hoffman, D.	American Health Foundation
Hogan G.	Bio-Dynamics
Homan, E.	Union Carbide Corporation
Hopstein, P.	University of Southern California
Hughes, H.	Baylor College of Medicine
Huff, J.	National Institute of Environmental Health Sciences
James, J.	University of California, San Francisco
Jasty, V.	G.D. Searle and Company
Johanssen, F.	Monsanto Company
Johnson. C.	Litton Bionetics, Inc.
Kaplan, S.	Hoffman LaRoche Incorporated
Kesterson, D.	Abbott Laboratories
Klaassen, C.	University of Kansas Medical Center
Kluewe, W.	National Institute of Environmental Health Sciences
Knesevitch, A.	Bio-Dynamics
Kociba, R.J.	Dow Chemical USA
Kocsis, J.	Thomas Jefferson University
Kolaja, G.	The Upjohn Company
Kotsonis, F.	G. D. Searle and Company
Lamprecht, E.	3M-Riker Laboratories
Lauterburg, B.	Baylor College of Medicine
Levine, W.	Albert Einstein College of Medicine

<u>NAME</u>	<u>ORGANIZATION</u>
Levinskas, G.	Monsanto Company
Lewis, S.	Exxon Corporation
Lombardi, B.	University of Pittsburgh Medical School
Matthews, H.	National Institute of Environmental Health Sciences
McCoy, J.R.	Rutgers Medical School (CMDNJ)
McCreesh, A.	U.S. Army Environmental Hygiene Agency
Meckler, F.	Litton Bionetics Incorporated
Michalopoulos, G.	Duke Medical Center
Mitchell, J.	Baylor College of Medicine
Moody, D.	University of California, San Francisco
Neal, R.A.	Vanderbilt University
Nelson, R.	3M-Riker Laboratories
Newberne, P.	Massachusetts Institute of Technology
Ogrodnick, J.	Bio-Dynamics
O'Neil, J.	Temple University School of Medicine
Parent, R.	Food and Drug Research Laboratories
Pariza, M.	Food Research Institute
Piper, R.	The Upjohn Company
Pitot, H.	University of Wisconsin
Popp, J.	Chemical Industry Institute of Toxicology
Pfitzer, E.	Hoffman LaRoche Incorporated
Reynolds, E.S.	University of Texas (UTMB)

<u>NAME</u>	<u>ORGANIZATION</u>
Rinehart, W.	Bio-Dynamics
Russell, T.	Bio-Dynamics
Scala, R.	Exxon Corporation
Schwetz, B.A.	Dow Chemical USA
Shank, R.	University of California, Irvine
Shellenberger, T.	Midwest Research Institute
Shinozuka, H.	University of Pittsburgh Medical School
Sinica, A.	University of Wisconsin
Sipes, G.	University of Arizona
Smith, C.	Baylor College of Medicine
Smuckler, E.	University of California, San Francisco
Snyder, R.	Thomas Jefferson University
Staab, R.	Exxon Corporation
Steffen, R.	3M-Riker Laboratories
Steinberg, M.	Hazleton Laboratories
Stevens, D.	The Upjohn Company
Swaney, J.	Albert Einstein College of Medicine
Swensen, D.	The Upjohn Company
Van Duuren, B.	New York University Medical Center
Webster, H.	The Upjohn Company
Weir, R.	Litton Bionetics Incorporated
Williams, G.	American Health Foundation

<u>NAME</u>	<u>ORGANIZATION</u>
Williams, G.	Naylor Dana Institute
Witmer, C.	Thomas Jefferson University
Wright, P.	Monsanto Company
Yang, R.	Union Carbide Corporation
Yuan, Y.	The Upjohn Company
Zimmerman, H.	George Washington University Hospital

# DISTRIBUTION LIST

25 copies	Commander US Army Medical Bioengineering Research and Development Laboratory ATTN: SGRD-UBG Fort Detrick Frederick, MD 21701
4 copies	USAMRDC (SGRD-RMS) Fort Detrick Frederick, MD 21701
12 copies	Defense Technical Information Center (DTIC) ATTN: DTIC-DDA Cameron Station Alexandria, VA 22314
1 copy	Dean School of Medicine Uniformed Services University of the Health Sciences 4301 Jones Bridge Road Bethesda, MD 20014
1 copy	Commandant Academy of Health Sciences, US Army ATTN: AHS-COM Fort Sam Houston, TX 78234
1 copy	Commander US Army Medical Bioengineering Research and Development Laboratory ATTN: SGRD-UBD-A/Librarian Fort Detrick Frederick, MD 21701

